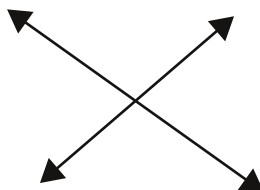


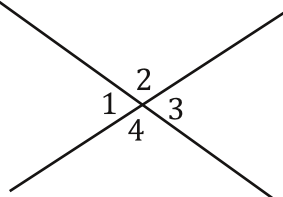
Vertical Angle Theorem

X marks the spot.

Okay, so vertical angles aren't nearly as fun to find as buried pirate treasure, but fortunately you don't have to sail the seven seas to find them. All you have to do is look for the "X". No, not the variable, but intersecting lines in the form of an X like this.

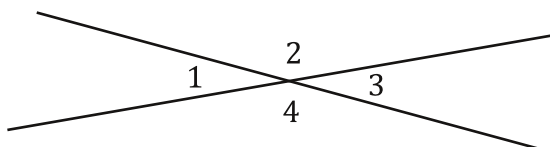


All you have to remember is that the angles on opposite sides of the x from one another are equal. Like this...



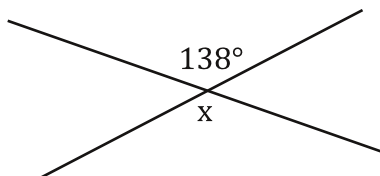
$$m\angle 1 = m\angle 3 \text{ and } m\angle 2 = m\angle 4$$

Pretty easy, huh? Here is an easy hint. It's impossible to draw a diagram without the vertical angles looking equal. So for vertical angles if they look equal they are equal. Watch...



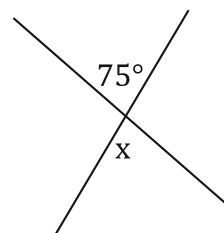
Angle 1 looks like it has the same measure as angle 3 doesn't it? "Yup," you say "they are both acute." Arrrrr maity! You'll walk the plank for callin' me angles cute! Okay, so maybe you won't be shark food, but you are correct. Also, angles 2 and 4 look the same and they both look obtuse. (By the way, just remember you can't count on an angle being a certain measure just because it looks like it. In this case we are only saying they LOOK equal, so they will be, but angles that look acute might not actually be.) Great, let's try some problems with vertical angles.

1. Find the measure of x.



Step 1. Write out the equation and relationship.

$$x = 138^\circ \text{ Vertical Angle Theorem}$$



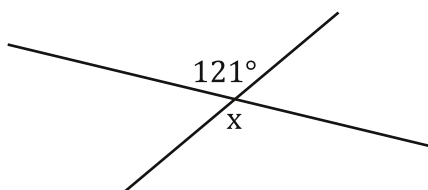
Step 1. Write out the equation and relationship.

$$x = 75^\circ \text{ Vertical Angle Theorem}$$

Great, keep going!

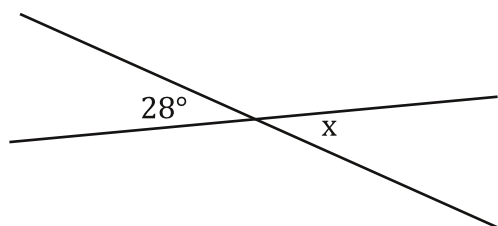
For each, state the angle relationship and find the value of x.

1.

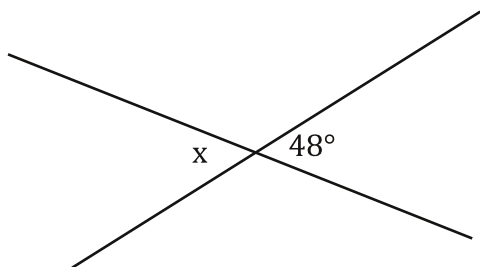


Step 1. Write out the equation and relationship.

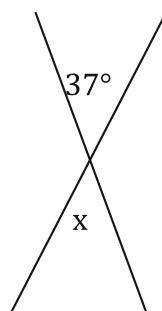
3.



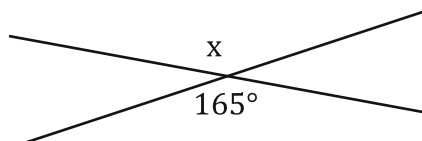
5.



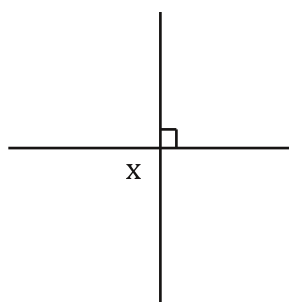
2. Don't forget to keep writing the relationship!



4.



6.



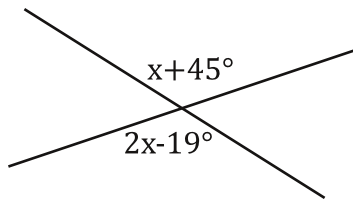
Bubble all the correct answers from above. Don't bubble incorrect answers.

☐ 37°
 ☐ 48°
 ☐ 59°
 ☐ 121°
 ☐ 143°
 ☐ 28°
 ☐ 152°
 ☐ 165°
 ☐ 90°
 ☐ 15°

For each, state the angle relationship and solve for x .

x .

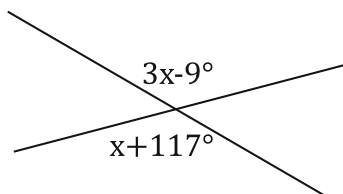
7.



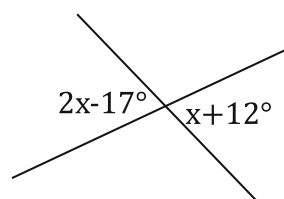
$$x + 45^\circ = 2x - 19^\circ \text{ Vertical Angle Theorem}$$

$$\begin{array}{r} -x \quad -x \\ 45^\circ = x - 19^\circ \\ -19^\circ \quad -19^\circ \\ 26^\circ = x \end{array}$$

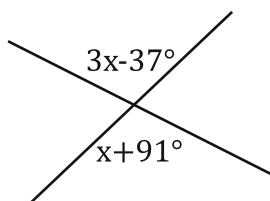
9.



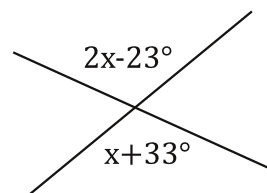
10.



11.



12.

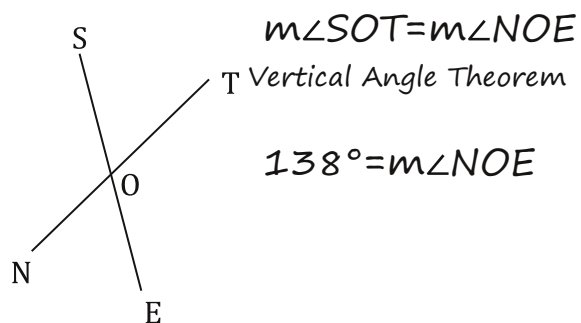


Bubble all the correct answers from above. Don't bubble incorrect answers.

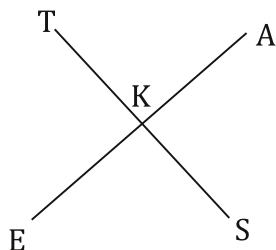
☐ 65° ☐ 38.6° ☐ 63.3° ☐ 26° ☐ 63° ☐ 56° ☐ 64° ☐ 36° ☐ 27° ☐ 29°

You're doing great. Now try these! Write the given information on the diagram, state the angle relationship, and solve for the indicated angle.

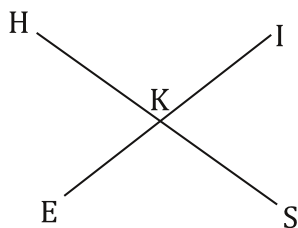
13. $m\angle SOT = 138^\circ$ Find $m\angle NOE$.



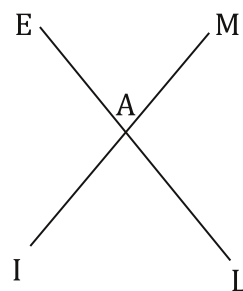
15. $m\angle TKE = 87^\circ$ Find $m\angle AKS$.



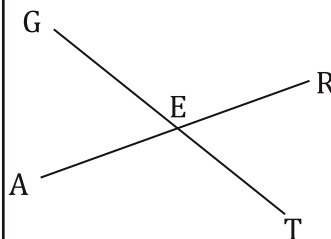
17. $m\angle IKS = 51^\circ$ Find $m\angle HKE$.



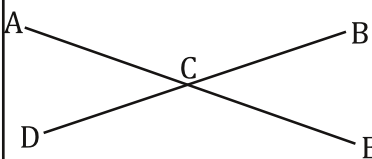
14. $m\angle EAM = 63^\circ$ Find $m\angle IAL$.



16. $m\angle GER = 147^\circ$ Find $m\angle AET$.



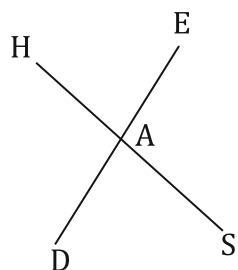
18. $m\angle DCE = 153^\circ$ Find $m\angle ACB$.



Bubble all the correct answers from above. Don't bubble incorrect answers.

☐ 138° ☐ 51° ☐ 117° ☐ 93° ☐ 33° ☐ 129° ☐ 153° ☐ 147° ☐ 63° ☐ 87°

19. $m\angle HAE = x + 24^\circ$, $m\angle DAS = 2x - 8^\circ$ Find $m\angle DAS$.



$m\angle HAE = m\angle DAS$
Vertical Angle Theorem

$$x + 24^\circ = 2x - 8^\circ$$

$$-x \quad -x$$

$$24^\circ = x - 8^\circ$$

$$+8^\circ \quad +8^\circ$$

$$32^\circ = x$$

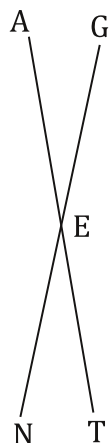
$$m\angle DAS = 2x - 8^\circ$$

$$m\angle DAS = 2(32) - 8^\circ$$

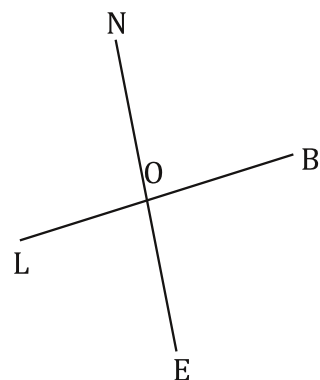
$$m\angle DAS = 64 - 8^\circ$$

$$m\angle DAS = 56^\circ$$

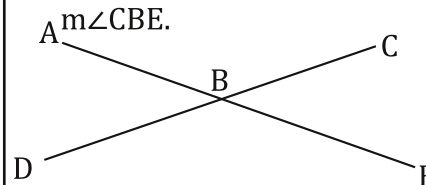
21. $m\angle GET = 3x - 51^\circ$, $m\angle AEN = 2x - 17^\circ$
Find $m\angle GET$.



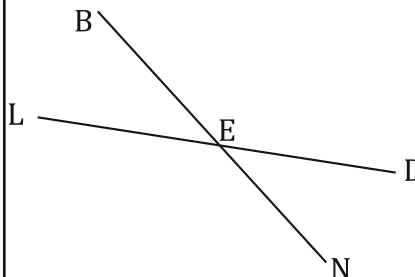
23. $m\angle BOE = 5x + 36^\circ$, $m\angle NOL = 3x + 42^\circ$
Find $m\angle NOL$.



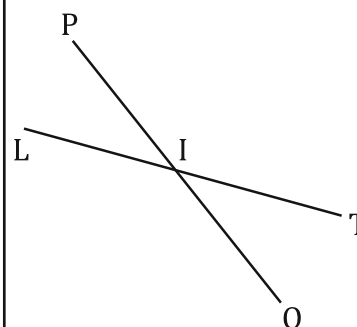
20. $m\angle ABD = 2x - 37^\circ$, $m\angle CBE = x - 65^\circ$ Find $m\angle CBE$.



22. $m\angle LEN = x + 89^\circ$, $m\angle BED = 2x + 89^\circ$
Find $m\angle BED$.



24. $m\angle PIT = 4x - 51^\circ$, $m\angle LIO = 3x^\circ$ Find $m\angle LIO$.



Bubble all the correct answers from above. Don't bubble incorrect answers.

☐ 28° ☐ 51° ☐ 167° ☐ 51° ☐ 68° ☐ 89° ☐ 0° ☐ 56° ☐ 0° ☐ 153°